Short-Term Effects of Manual Therapy on Balance: A Multicenter, Randomized, Double-Blind Controlled Trial

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Abstract

Objective: The purpose of this study was to analyze short-term changes in dynamic and static balance after a manual therapy protocol in healthy participants and analyze any repercussions on mood and perception of change after applying articulatory techniques.

Methods: A single-blind, randomized, multicenter clinical trial was conducted. Participants were allocated to either a manual therapy group (MTG) (n = 101) or a control group (CG) without intervention (n = 99), and measures were taken before treatment, after the intervention, and 1 week after treatment. Assessments included the Star Excursion Balance Test, Unipedal Stance Test (UPST), Profile of Mood States (POMS), and Patient Global Impression of Change (PGIC) scale.

Results: Two hundred healthy participants completed the study (mean age, 22 [SD = 2.67]). There was a statistically significant interaction between groups and time measurements in the right leg for anterior ($P = .003$), posteromedial ($P < .001$), and posterolateral ($P = .001$) directions in favor of the MTG, as well as in the left leg for anterior ($P < .001$), posteromedial ($P < .001$), and posterolateral ($P = .012$) directions. The analysis failed to show statistically significant interactions between any of the factors for the UPST and POMS ($P > .05$). The MTG showed a significant improvement compared to the CG after treatment ($P = .003$) and at 1-week follow-up ($P < .001$) on the PGIC scale.

Conclusion: The results suggest the MT intervention was effective on dynamic balance in post-intervention in healthy participants, and some of the directions maintained the results at 1-week follow-up. Perception of change in post-treatment and 1-week follow-up also significantly improved. The protocol did not seem to produce changes in static balance and mood states. Positive changes after manual therapy were maintained in the short term. (J Manipulative Physiol Ther 2023;00;1-9)

Key Indexing Terms: *Musculoskeletal Manipulations; Postural Balance; Mood Disorders; Healthy People Programs*

Introduction

Maintaining balance is an essential requirement in everyday functional movements and physical exercise.[1,2] Human body balance is a complex process, which includes the harmonized coordination of sensory information (visual, vestibular, and somatosensory), the musculoskeletal system, and the central and peripheral nervous system.[3] Both dynamic and static balance are relevant factors in gait,[4] postural stability,[5,6] and injury prevention in various populations.[7] Moreover, the assessment of static and dynamic balance is an important predictor of musculoskeletal injuries.[8]

Dynamic and static balance in healthy people has been studied before.[9-11] Specifically, in young people, it has been shown that general balance can be improved by therapeutic exercise,[12] as well as by muscle stretching,[13] whereas physical activity or sensorimotor training[14,15] has shown to improve static balance.

Manual therapy (MT) is a valid option to improve balance and other variables in healthy individuals. A previous study showed that MT (ie, applying thrust and non-thrust

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manipulations) and proprioceptive neuromuscular facilitation improved dynamic balance in the 1-week post-treatment assessment of hockey players.[16] Also, MT, such as rearfoot manipulation, has also shown improvement on dynamic balance of healthy participants.[17]

Evidence suggests that MT applied in several sessions could be optimal for improving musculoskeletal variables. In this line, a previous review highlighted that, in one of the reviewed studies, people with chronic ankle instability may have benefitted from MT when ankle mobility was applied at least 6 sessions, improving range of motion and function, and, therefore, it was postulated that 1 treatment session was insufficient to achieve significant changes in function.[18] However, 2 other studies in the same review showed a significant improvement using a single session in both dynamic and static balance,[18] thus pointing out that 1 single session of MT can improve balance in people with chronic ankle instability. Therefore, previous studies have mostly applied several sessions of MT in a single region of the lower limb and in people with pathology. Thus, it would be interesting to investigate the effects of an MT protocol directed not only at the foot but also at joint release of the entire lower limb chain and to observe the changes in static and dynamic balance in healthy participants.

Moreover, several studies have shown that static and dynamic postural control are linked to mood,[19,20] and even an upright walking posture has been associated with a positive attitude, less drowsiness, less pain, and greater feelings of power.[21] In this line, a previous study has evaluated the mood state of athletes after treatment through MT.[22] On the other hand, other studies confirmed that stress levels can affect postural stability, especially with eyes closed, in healthy young people.[23,24] Therefore, balance is essential, not only in pathologies, athletes, or older adults, but it could also play an important role in the general population to prevent injuries, offer a preventive option, and help in the motivational aspect.

To our knowledge, the effects of a 1-session MT reproducible and affordable protocol, both on balance and mood, in the short term in healthy young people have not yet been studied. The results of such a study could simplify duration and costs when trying to obtain positive changes. The application of MT in a large sample with healthy participants, without associated pathology, and assessing the effects produced by the therapeutic procedure can allow us to observe objectively the response that it has in balance. We hypothesized that the use of a 1-session MT protocol in healthy participants would obtain better short-term results than no intervention for balance and that such benefits could last in the short term. Therefore, the primary aim of this study was to compare the effectiveness of an MT protocol on static and dynamic balance in healthy participants in the short term and to verify if changes are maintained 1 week after the intervention. A secondary aim was to assess mood changes and perception of change after treatment.

Methods

Design

A single-blind, multicenter, randomized controlled trial was conducted. Participants were divided into the following 2 groups: an experimental MT group (MTG) that received a single MT session and a control group (CG) without intervention. Dynamic balance, static balance, and mood state were assessed at baseline and 1 week after, and perceived changes post-treatment. The study protocol was approved by the Human Research Ethics Committee of the University of Valencia (Spain) (H1540799023399). All procedures were conducted according to the Declaration of Helsinki. The participants were informed in detail about the procedure, voluntarily participated in the study, and signed the informed consent document. All evaluations and interventions were performed by physiotherapists experienced in the use of MT. The study was implemented following the Consolidated Standards of Reporting Trials (CONSORT) extension for pragmatic clinical trials.[25] This study was prospectively registered at www.ClinicalTrials.gov (ClinicalTrials.gov identifier: NCT04444414).

Participants

The sample consisted of healthy participants aged between 18 and 39 years. Participants were recruited from July to November 2020 at the University of Valencia (Spain) and Charles University (Prague). Inclusion criteria were age older than 18 years and willingness to participate. Exclusion criteria were as follows: taking part in a balance training program; having a medical diagnosis related to a balance condition, regardless of whether the cause is vestibular, visual, or proprioceptive, or surgery; suffering from tingling or numbness; pain in the lower limbs, scoring over 3 on the visual analog scale; orthopedic problems or traumatic injuries in the lower limbs or in the lumbosacral region, including scoliosis, ligament pathologies, osteoarthritis, and prostheses; or pregnancy.

Randomization and Blinding

Participants were randomly assigned to the MTG or CG. Individual and sequentially numbered index cards with the random assignment were prepared, folded, and placed in sealed opaque envelopes. The clinicians administering the self-reported outcome questionnaires were blinded to the patient's treatment group assignment. The outcomes assessor was external to the study, unaware of group allocation and the aim of the study. The analysis was conducted by an external statistician.

Intervention

Manual Therapy Group. The experimental group received a single 20-minute MT intervention. This program was based on the protocol developed by Espí-Lopez et al,[26] and time and repetitions were applied as in Espí-Lopez et al.[16] The program consisted of the following: (1) lumbopelvic thrust manipulation of high velocity and low amplitude (lateral decubitus position), with a maximum of 2 thrusts on each side; (2) anterior to posterior non-thrust manipulation of the hip (supine, 25 repetitions); (3) lateral-to-medial non-thrust manipulation of the knee (supine, 25 repetitions); (4) proximal tibiofibular joint posterior to anterior non-thrust manipulation (supine, 25 repetitions); (5) rearfoot distraction thrust manipulation of high velocity and low amplitude (supine, maximum of 2 thrusts); (6) stretching of the external rotator muscles of the hip (10 minutes); and (7) fascial manipulation in the patellofemoral region (10 minutes). Participants were asked to report any adverse events during the study.

Control Group. The CG received no intervention, and only assessments were performed.

Outcome Measures

Prior to the start of the study, height (m), weight (kg), and leg length (cm) were recorded. Assessments were performed before treatment, immediately after the intervention, and 1 week after the intervention.

Primary Outcome: Dynamic Balance. The Star Excursion Balance Test (SEBT)[27] is considered a highly representative non-instrumented dynamic balance test in physically active individuals. The SEBT has proven to be a reliable measure and valid as a dynamic test to predict the risk of lower limb injury, to identify dynamic balance deficits in patients with a variety of lower limb conditions, and to respond to training programs in both healthy people and people with lower limb injuries.[28,29] The test is performed in a standing position and consists of maintaining a stable base of support by performing reaching movements with each lower limb in 3 directions (anterior, posterolateral, and posteromedial), while the other limb remains fixed at a set point.[30] Prior to the assessment, the volunteers practiced the test 4 times to minimize learning effects. After resting for 5 minutes, the participants performed the assessment test, recording 3 reaches in each direction with each leg. For the analysis, the mean of the 3 attempts with a 10-second bipedal stance rest between each attempt was taken into account.[31] Since the performance of the test is strongly correlated with leg length,[28] each reach distance was normalized in accordance with the participant's leg length (measurement from the anterior superior iliac spine to the medial malleolus)[28] using the following formula:

$$dn = \left(\frac{\mathrm{da}}{l}\right) \times 100$$

where *dn* is the normalized distance, *da* reach distance, and *l* leg length.

Secondary Outcomes: Static Balance. Static balance was assessed with the Unipedal Stance Test (UPST). A chronometer was used to assess the time the participant was able to maintain monopodal support. Participants focused on a fixed point that was marked on the wall and performed single leg support. Before lifting the lower limb being assessed, which would determine the start of the test, the participant crossed their arms at chest level, resting each hand on the respective opposing shoulder. When ready, participants closed their eyes to allow a more specific assessment of the somatosensory capacity of the individual[32] and then raised the lower limb; the time they managed to hold this position was measured with a stopwatch. This procedure was then performed with the other leg. The analysis took into account the means of the 3 test repetitions and the longest time in the best repetition. Participants focused on a fixed point marked on the wall and performed single-leg support. Before lifting the lower limb being assessed, which determined the start of the test, the participants crossed their arms at chest level, resting each hand on the respective opposing shoulder. When ready, participants closed their eyes and raised the lower limb, and the time they managed to hold this position was measured with a stopwatch. This procedure was then performed with the other leg.

Mood. The mood was assessed with a Profile of Mood States (POMS). This questionnaire consists of 58 items, valued using a Likert-type format, with 5 possible response alternatives (0 = not at all, 4 = extremely). Based on this test, a general index of partially measured mood alteration can be extracted, including tension, depression, anger, vigor, fatigue, and confusion. Reliability coefficients (Cronbach's alpha) for the factors ranged from 0.76 (confusion) to 0.91 (anger).[33]

Perception of Change. The perception of change after the intervention was measured by the Patient Global Impression of Change (PGIC). This reflects the change perceived by the participant after treatment. This tool evaluates said perception on a qualitative scale that ranges from 1 ("very much improved") to 7 ("very much worse"). On the other hand, it also involves a quantitative visual analog scale that classified the improvement from 0 to 10, the former being a very good improvement and the latter being significant worsening after treatment. Lower values, therefore, indicate greater perception of improvement.[34]

Sample Size Determination

Sample size was calculated for an effect between groups (F = 0.25),[28] with an alpha level of 0.05 and a power (β) of 90%; a total of 60 participants (30 for each group) were estimated. Considering the possible dropout rate in the second assessment, post-treatment evaluation, facilitate additional analyses, and enhance the overall quality and generalizability of the study findings more participants could be recruited. G-Power 3.1. was used for sample size estimation (Institute for Experimental Psychology, University of Düsseldorf, Düsseldorf, Germany).

Statistical Analysis

Statistical analysis was performed using SPSS v.24 (IBM Corp, Armonk, NY). Means, SDs, and/or 95% CIs were calculated for each variable. The assumption of homoscedasticity was requested using Levene's test, and the sphericity was evaluated using Mauchly's test. The Kolmogorov-Smirnov test revealed a normal distribution of the variables ($P > .05$). The inferential analyses of the data were conducted using a 2-factor mixed multivariate analysis of variance (MANOVA), having a between-participant factor "treatment group" with 2 categories (MTG and CG) and a within-participant factor "time" with 3 categories (pre-treatment, post-treatment, and 1-week-follow-up) for the SEBT, UPST, and POMS variables. Post hoc analyses were implemented to detect differences between groups. Significance level was updated using the Bonferroni correction. A χ^2 test was used for the qualitative PGICS variable and a MANOVA for the continuous PGICS variable with only 2 categories in the within-participant factor (post-treatment and 1-week follow-up). The α level was set below 0.05 for all tests, except for the post hoc analyses because, considering that there were 18 comparisons, the Bonferroni-corrected significance level was 0.0027. For the effect size Cohen's d was computed, whereby the effect size was rated as follows: small (0.20-0.50), medium (0.50-0.80), or large (>0.80).

Results

A total of 211 participants were eligible, and finally 200 were included and analyzed (Fig 1). Mean age was 22 (SD = 2.67) years, and 137 (68.50%) were women. One hundred and one participants (50.50%) were randomly allocated to the MTG and 99 (49.50%) to the CG. Demographic and anthropometric data of participants are shown in Table 1. According to Mauchly's test, sphericity was assumed for the variables UPST right and left legs ($P >$ .05), whereas it was not assumed for the variables SEBT right and left legs and POMS ($P < .05$).

In relation to the SEBT, the MANOVA analysis showed a statistically significant interaction between the factors "treatment group" (MTG and CG) and "time" (pre-treatment, post-treatment, 1-week follow-up) in the right leg for anterior (F = 5.793; $P = .003$; $\eta^2 = 0.030$), posteromedial (F = 8.730; $P < .001$; $\eta^2 = 0.044$), and posterolateral (F = 7.571; $P = .001$; $\eta^2 = 0.038$) directions and in the left leg for anterior (F = 9.141; $P < .001$; $\eta^2 = 0.046$), posteromedial (F = 16.875; $P < .001$; $\eta^2 = 0.082$), and posterolateral (F = 4.479; $P = .012$; $\eta^2 = 0.023$) directions. However, the MANOVA analysis failed to show statistically significant interactions between any of the factors for the UPST or the POMS ($P \geq .05$ for all). Between groups post hoc analyses for all the variables are shown in Table 2.

In relation to the qualitative PGIC scale, MTG showed statistical differences compared to CG at post-treatment and the 1-week follow-up ($P = .04$ and $P = .04$, respectively). Moreover, 53% of MTG felt much better (answered "very much improved" or "much improved") at post-treatment, while these answers were 26% of CG. After 1-week follow-up, 26% of participants in the MTG still felt much better (answered "very much improved" or "much improved") versus 10% in the CG. On the other hand, considering that lower scores imply greater improvement, the quantitative PGIC visual analog scale showed significant differences between groups at post-treatment (MTG: 2.73 [SD = 1.31]; CG: 3.49 [SD = 1.50]; $P = .0039$) and at 1-week follow-up measurements (MTG: 3.50 [SD = 1.33]; CG: 4.45 [SD = 1.37]; $P < .0001$).

Discussion

The results of this study showed that a single session of lumbopelvic and lower limb MT protocol had significant changes in dynamic balance in both legs for most of the directions at post-treatment and for some of the directions at 1-week follow-up. In addition, the results showed a small or medium effect size. In terms of perception of change, the MTG showed a significant improvement after treatment and at 1-week follow-up on both the quantitative PGIC visual analog scale and the qualitative PGIC scale. However, there were no significant changes in static balance and mood state, although there was an improvement trend for the MTG.

The results showed an improvement in dynamic balance in the posterolateral, posteromedial, and anterior directions in both legs, which remained at 1-week follow-up, with the exception of the anterior direction. As previously stated, balance and stability in both legs are essential for preventing falls and injuries.[7] Considering that the SEBT has been previously shown to be a reliable predictor of lower limb injuries in athletes,[35] this aspect should also be taken into account in the general population. Based on the obtained results, it is confirmed that a therapeutic approach focused on the lumbar spine and joint stability of the entire lower limb would lead to important benefits in the prevention of injuries.[36] Previously, another study confirmed that this protocol based on mobility and joint decompression showed better joint stability in athletes.[16] Therefore, we can explain the improvement in our sample, although composed of healthy participants, by the protocol; thus, this offers the possibility of using this protocol to prevent and, ultimately, improve functional and musculoskeletal aspects after its application. In that sense, we know that new-onset

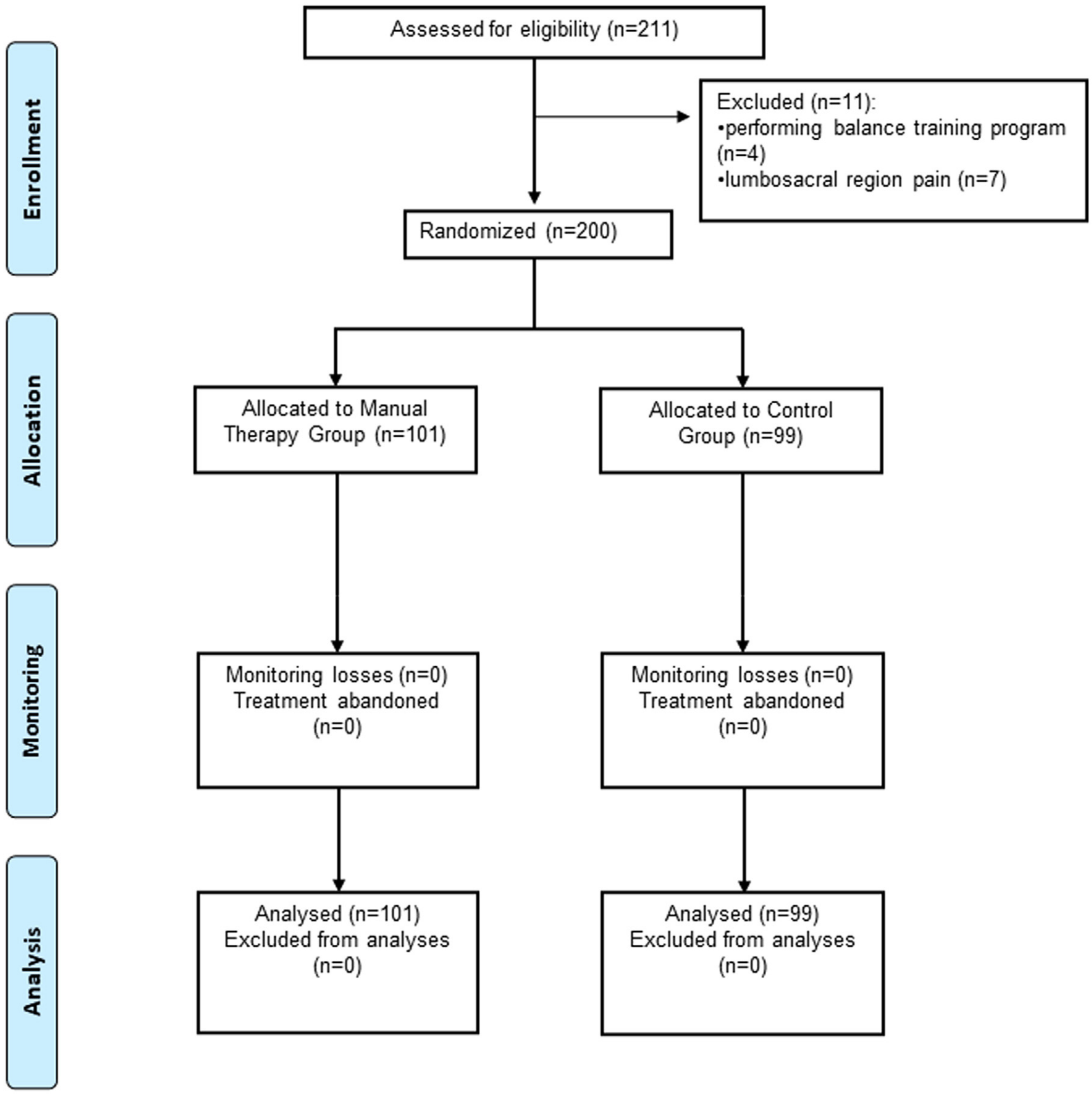

Fig 1. *Flowchart according to the CONSORT statement for the reporting of randomized trials. CONSORT, Consolidated Standards of Reporting Trials.*

musculoskeletal disorders have a deleterious effect on physical health-related quality of life, with lesser effects on social and mental functioning; thus, like Roux et al,[37] the recommendations for early treatment and primary prevention are reinforced. On the other hand, an area to consider is health related to work, which implies the majority of the population. In this sense, the World Health Organization[38] also alludes to musculoskeletal prevention for the well-being of people, and this aspect is part of the competencies that health care professionals, such as physiotherapists, have to take into account. Among the techniques used in physiotherapy, mobilization, body awareness therapy, manipulation, and massage are included and have been shown to be beneficial in reducing pain and increasing function.[39,40]

On the other hand, lower limb balance can greatly prevent the overload of the lumbosacral region.[41] The positive results of our study imply that the use of these techniques can prevent injuries since young people are a risk population based on the amount of physical activity they perform. Thus, a study revealed that university-level athletes suffered on average more than 2 injuries each year, with ankle and knee injuries being the most frequently reported.[42] In this sense, our study aimed to improve stability based on joint intervention at different levels. This intervention could influence the prevention of injuries; however, it was

Table 1. *Demographic and Anthropometric Characteristics of the Participants*

Characteristic	MTG n = 101 (50.5%) Mean (SD) or n (%)	CG n = 99 (49.5%) Mean (SD) or n (%)	*P* Value
Age (y)	22 (2.09)	22 (3.17)	.527
Sex (men/women)	27 (26.7%)/74 (3.27%)	36 (36.36%)/63 (63.63%)	.143
Height (m)	1.70 (0.09)	1.71 (0.09)	.517
Weight (kg)	64.81 (10.80)	66.7 (11.18)	.226
Length of right leg (cm)	87.80 (4.97)	88.80 (5.58)	.182
Length of left leg (cm)	87.79 (5.04)	88.80 (5.56)	.179
Dominant leg (right/left)	89 (88.10%)/12 (11.90%)	90 (90.90%)/9 (9.10%)	.520

CG, control group; *MTG*, manual therapy group.

not our objective to assess the risk of injuries, although other authors have previously shown benefits in this regard.[16,41]

However, static balance and mood state did not obtain positive results, although involving young individuals. These results would probably have had greater effects in individuals with neurologic alterations or pathologies and would have resulted in balance and mood changes. Therefore, we consider that perhaps a single session cannot produce significant changes in static balance or mood, probably due to the age of the participants of the study or the short duration of the intervention. On the other hand, suitable training for a postural change and at the same time with an impact on mood should focus on the upper body region such as the shoulder girdle or back since gait patterns of some clinically depressed people reflect a slumped posture, reduced arm swing, and reduced up-and-down movements of the head.[43]

In relation to perceived change, the MTG showed a significant improvement compared to the CG after treatment and at 1-week follow-up, both on the quantitative PGIC visual analog scale and the qualitative PGIC scale. In fact, after treatment, 53% of participants felt that they had improved a lot or quite a lot, and 26% maintained this improvement.[44,45] We have not found previous studies that evaluate the perception of change by MT in healthy participants and its influence on balance and other variables using these techniques. However, other studies have evaluated MT in hockey players, where positive changes were obtained in lateral and medial dynamic balance at 1-week post-treatment, as well as in dorsal flexion of the ankle and in lumbar flexibility.[16] Therefore, although our results cannot be compared with those achieved by other authors, we can affirm that MT protocols obtained conclusive results in different samples regarding the perception of change.

Our study has demonstrated short-term effects on balance with only 1 session of MT. This is important since good stability positively impacts other physical abilities and can reduce falls and injuries. In our study, the perception of change also improved; however, other variables, such as static balance or mood, did not improve.

This MT protocol has been applied in young athletes and in participants with patellar femoral syndrome,[26] showing good results for various musculoskeletal variables. In this regard, the combination of several techniques applied both to the lumbosacral region and the lower limbs in 1 session reaffirms its effectiveness for functional variables.

Limitations and Strengths

As for the limitations, we did not consider the effects that the application of this protocol could have on posture or functionality, which would provide more information, although it was not the objective of this study. In addition, to achieve emotional changes, a multicomponent protocol would probably be needed. Furthermore, there was no long-term follow-up to see if the protocol was truly effective. In this regard, it should be taken into account that a short-term follow-up only allows one to make a conclusion about short-term change but not durability or clinical effectiveness expected by patients, payors, and providers. Strengths of this study include the fact that this is a multicenter study with an adequate sample size. Although previous studies have applied different MT techniques, with several sessions, in individuals with pathologies or in athletes, in our study with a single session, we have already been able to achieve good results in terms of balance, which decreases the application time and can reduce costs to produce a positive effect. Future studies could evaluate if this protocol can produce any changes in areas such as the lumbar region, hip, or knee.

Table 2. *Effect of the Treatment on Balance and Mood State by Time and Group*

Variable	Group	Time—Mean (SD) Pre-treatment	Post-treatment	1-Week Follow-Up	Mean Differences Between Groups (post-treatment) (95% CI); *P* Value; Effect Size (d)	Mean Difference Between Groups (1-wk follow-up) (95% CI); *P* Value; Effect Size (d)
Balance						
SEBT, right leg						
Anterior	MTG	69.89 (6.79)	72.49 (6.57)	72.75 (6.29)	2.19 (0.27-4.11); *P* = .025	1.46 (−0.43 to 3.35); *P* = .130
	CG	69.46 (7.05)	70.30 (6.89)	71.29 (6.99)		
Posteromedial	MTG	81.09 (10.01)	85.84 (9.66)	86.62 (8.16)	3.55 (0.74-6.36); *P* = .014	2.85 (0.27-5.42); *P* = .030
	CG	80.28 (9.98)	82.29 (10.09)	83.77 (9.88)		
Posterolateral	MTG	86.52 (8.02)	91.14 (7.53)	91.66 (7.23)	4.15 (1.88-6.41); *P* < .001[a]; d = 0.52	3.02 (0.85-5.19); *P* = .007[a]; d = 0.40
	CG	85.02 (8.55)	86.99 (8.39)	88.64 (7.99)		
SEBT, left leg						
Anterior	MTG	70.35 (6.02)	73.21 (6.35)	73.22 (5.91)	2.45 (0.58-4.32); *P* = .011[a]; d = 0.37	1.82 (−0.02 to 3.66); *P* = .046
	CG	69.93 (6.98)	70.76 (6.81)	71.40 (7.00)		
Posteromedial	MTG	79.20 (9.8)	85.60 (9.60)	86.25 (8.23)	4.2 (1.47-6.93); *P* < .001[a]; d = 0.44	3.65 (1.16-6.14); *P* < .001[a]; d = 0.42
	CG	79.07 (9.62)	81.40 (9.59)	82.61 (9.25)		
Posterolateral	MTG	88.08 (8.11)	91.72 (7.92)	92.13 (6.99)	3.56 (1.3-5.81); *P* < .001[a]; d = 0.45	2.71 (0.55-4.86); *P* = .014
	CG	86.46 (7.74)	88.16 (7.90)	89.42 (8.11)		
UPST, right leg	MTG	27.84 (12.79)	31.61 (13.10)	31.01 (12.63)	0.57 (−3.12 to 4.26); *P* = .760	2.03 (−1.61 to 5.68); *P* = .273
	CG	26.43 (13.03)	31.04 (12.80)	28.98 (13.00)		
UPST, left leg	MTG	28.43 (12.18)	33.59 (12.28)	33.58 (11.66)	2.56 (−1.04 to 6.17); *P* = .163	2.08 (−1.40 to 5.56); *P* = .240
	CG	27.42 (13.46)	31.03 (13.06)	31.50 (12.79)		
Mood state						
POMS	MTG	118.46 (22.95)	111.45 (25.31)	113.85 (23.78)	−6.88 (−14.34 to 0.58); *P* = .071	−0.08 (−0.28 to 0.11); *P* = .391
	CG	122.12 (28.05)	118.33 (27.10)	117.81 (23.24)		

Cohen's d effect size was calculated for comparisons in which a statistically significant difference was obtained.
CG, control group; *MTG*, manual therapy group; *POMS*, Profile of Mood States; *SEBT*, Star Excursion Balance Test; *UPST*, Unipedal Posture Test.
[a] Significant differences between groups. Bonferroni-corrected significance level = 0.0027.

Conclusion

The results suggest that the MT intervention was effective on dynamic balance for most of the directions in healthy participants at post-treatment, as well as in perceived change. At 1-week follow-up, some of the improvements were maintained in dynamic balance and also in perceived change. However, the present protocol did not produce changes in static balance and mood states.

Funding Sources and Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): G.V.E-L., D.P, A.A-G., E.M-S.

Design (planned the methods to generate the results): G.V.E-L., D.P, A.A-G., E.M-S.
Supervision (oversight, organization and implementation): G.V.E-L., D.P, E.M-S.
Data collection/processing (experiments, organization, or reporting data): G.V.E-L., D.P, A.A-G., E.M-S.
Analysis/interpretation (analysis, evaluation, presentation of results): E.M-G, A.M-M.
Literature search (performed the literature search): G.V.E-L., D.P, E.M-S.
Writing (responsible for writing a substantive part of the manuscript): G.V.E-L., D.P, A.A-G., E.M-G, A.M-M., E.M-S.
Critical review (revised manuscript for intellectual content): G.V.E-L., D.P, A.A-G., E.M-G, A.M-M., E.M-S.

Practical Applications

- This manual therapy protocol focused on the lumbar region and lower limbs.
- This protocol improved dynamic balance and perception of change.
- Positive changes after manual therapy were maintained in the short term.
- The application of this protocol offers a therapeutic option for clinicians.

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